

**USER MANUAL**

**SANDAR** Prosan Protocol

**SC2000 MATRIX CONTROLLER**  
from release 2.9 991001



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## 1 THE PROSAN PROTOCOL

### 1.1 Reading and writing Prosan messages

For communication between units, FTG Sandar TeleCast Norge AS uses her own protocol. Messages between the units are transferred as records, i.e. data between unique start and stop characters. As soon as a complete record is received, the receiver returns the character **ACK** (06 hex) if the record is correct received and recognised. If the record is incorrectly received or not recognised, the receiver returns a **NAK** (15 hex) character. If the transmitter receives NAK (or no answer within about 2 seconds), it retransmits the message. The number of retransmissions and delay before a retransmission vary, depending on the actual system. Normally a maximum of 3 retransmissions is used.

The record has a checksum built in. This checksum is inserted between the last data character and the stop character. The checksum is modulo 256 sum of all data characters in the record. It is transmitted as 2 characters (hexadecimal). The record start character is **STX** (02 hex), and the record stop character is **ETX** (03 hex). ACK, NAK, STX and ETX cannot be transmitted as data characters.

Sample records:

**<stx>Q51<etx>**

This message asks the receiver to return status.

<stx> start character, hexadecimal 02  
 Q type of message (no more data with the message)  
 51 record checksum modulo 256, here 'Q' only (hex 51)  
 <etx> stop character, hexadecimal 03

The receiver should answer with ACK, and then assemble and transmit the answer:

**<stx>Q00B1<etx>**

Here are more data accompanying the 'Q', and therefore the checksum is also different (hex B1). Again the receiver of the message should return an ACK if accepted, otherwise a NAK should be returned.

*Full duplex transmissions are used. If a unit is transmitting and receiving records simultaneously, it is allowed to transmit **ACK** and **NAK** characters within the transmitted record, to notify the unit in the other end that a record is received. These control characters have no influence upon the checksum of the record being transmitted. Accordingly, the unit receiving a record also must expect that control characters can be mixed within the record being received.*

## 1.2 Prosan messages used by the system

### 1.2.1 General

This chapter lists the records used by the system when communicating with a host computer. Start, stop and checksum characters are omitted in this overview, and in most other examples. Remember to add these characters to the real records. In general up to eight levels (matrices) can be controlled. These matrices must be connected together with an Eibus. PROSAN messages are normally exchanged with the Eibus controller, but some can also be used to communicate with a tributary (slave) of the Eibus.

### 1.2.2 Alarm messages

#### 1.2.2.1 General

To use alarm messages option the Eibus controller must be set to enable these messages. When the option is enabled, alarm messages can be used when communicating with the Eibus controller or one of the Eibus tributaries with SYS2000 control software.

#### 1.2.2.2 Alarm message definitions

##### **AM<levels>**

Question for alarm status of any levels of the system.

**<levels>** list of levels (A through H), separated by commas. <levels> can be omitted, meaning "all levels".

Examples:

AM	ask for alarm status of all levels of the system.
AMA	ask for alarm status of level 1
AMB	ask for alarm status of level 2
AMG	ask for alarm status of level 7
AMH	ask for alarm status of level 8
AMA,B	ask for alarm status of level 1 and 2
AMC,D,F	ask for alarm status of levels 3, 4 and 6
AMA,B,C,D,E,F,G,H	ask for alarm status of levels 1, 2, 3, 4, 5, 6, 7 and 8

The last example could be substituted by the question AM, "ask for alarm status of all levels".

**AM<level><range>:<data>**

Return of status data asked for.

<b>&lt;level&gt;</b>	One of the letters <b>A</b> through <b>H</b> (level 1 through 8)
<b>&lt;range&gt;</b>	range of outputs controlled
<b>&lt;data&gt;</b>	<ESbus address>,<number of alarms>,<alarm id1>,<alarm id2>, . . .

Examples:

AM:0000,00	no matrix connected, possible answer to AM query
AMA001,064:8289,00	no alarms reported
AMB001,064:8287,01,0A	1 alarm reported (alarm 10)
AMC001,064:8283,01,04	1 alarm reported (alarm 4)
AMC065:128:8285,00	no alarms reported
AMD:0000,00	no matrix in level 4
AMF001,064:828B,00	no alarms reported
AMF065:128:828D,02,01,02	2 alarms reported (alarms 1 and 2)
AMF129,192:828F,01,04	1 alarm reported (alarm 4)

Range is expressed as decimal numbers, while ESbus address and alarms are expressed as hexadecimal numbers.

Note that the ESbus poll addresses are being used. The poll address has been chosen due to definition of other commands, which also use poll address for reference. Each unit has 2 ESbus addresses. These are data address and poll address. These addresses are equal except for bit 0. Poll address has bit 0 set, while data address has bit 0 reset. Typical address pairs are (8282, 8283) and (82fc, 82fd).

**1.2.2.3 Alarm number definitions**

The alarm messages report possible alarms in the system. Below is listed some of these alarms, associated by an alarm number:

01	No connection available to BC (ESbus error between tributary and ESbus controller)
02	Unit not responding to ESbus messages (poll/data)
03	Power alarm
04	Power alarm unit not responding

Alarm types 03 and 04 are optional. A power alarm unit must be attached to the ESbus, and alarm drivers included in the ESbus controller.

More alarm numbers can be added to this list.

### 1.2.3 Mnemonics

These messages can only be used between ESbus controller and host.

**DIAiii** Question for text stored for input “iii” in level 1. “A” is used for level 1, “B” for level 2, and so on. “iii” must be in the range 001 to 064 if the level is not linked with other levels to make a bigger matrix. For linked level matrices the number ranges from 001 to the maximum input number (64 x number-of-levels).

#### **DIAiii:ABCDABCDEFGH**

Answer to the question DIAiii. The text is always stored as 12 characters. The first 4 characters are the 4-character mnemonic of the input. The last 8 characters are the 8-character mnemonic of the input. The command can also be sent to the matrix controller to change the text.

#### **DOAooo**

Question for text stored for output “ooo” in level 1. “A” is used for level 1, “B” for level 2, and so on. “ooo” must be in the range 001 to 064 if the level is not linked with other levels to make a bigger matrix. For linked level matrices the number ranges from 001 to the maximum output number (64 x number-of-levels).

#### **DOAooo:ABCDABCDEFGH**

Answer to the question DOAooo. The text is always stored as 12 characters. The first 4 characters are the 4-character mnemonic of the output. The last 8 characters are the 8-character mnemonic of the output. The command can also be sent to the matrix controller to change the text.

### 1.2.4 Matrix status

These messages can be used between host and ESBUS controller, and between host and ESBUS tributary. Note that if used on a tributary, ESBUS connection to the bus controller must be working. If not the data can partly be incorrect.

**Mooo** Question for matrix status of output 'ooo'.

**Mooo:aaa,bbb,ccc,ddd,eee,fff,ggg,hhh**

Change matrix status for output 'ooo'. Up to eight matrices can be controlled.

'ooo' and 'aaa' to 'hhh' are decimal 3-digit numbers. When a matrix status shall be unchanged, use characters '---' instead of 'aaa' to 'hhh'.

Example: Switch output 5 to input 3 of the third matrix, and keep matrices 1 and 2 unchanged:  
M005:---,---,003.

The number of digits within the command can be selected to be 2 or 3. Default is 3 digits. This selection is done in the flash memory of the unit. Depending upon the selection made, the values should be entered as 'oo' and 'aa' to 'hh', or 'ooo' and 'aaa' to 'hhh'.

**SA** Host asks for status of first matrix (all outputs).

.

.

**SH** Host asks for status of matrix 8 (all outputs).

**SA:000,004,002,000,001,000,....,000,001**

Controller transmits status of the first matrix (level). The numbers separated by commas represent the matrix-input numbers. The corresponding output number is given by the position in the sequence. The first output is transmitted first.

**SB:000,004,002,000,001,000,....,000,001**

Controller transmits status of the second matrix (level).

.

.

**SH:000,004,002,000,001,000,....,000,001**

Controller transmits status of the 8th matrix (level).

The number of digits within the command can be selected to be 2 or 3. Default is 3 digits. This selection is done in the flash memory of the unit. Depending upon the selection made, the values should be entered as 'oo' and 'aa' to 'hh', or 'ooo' and 'aaa' to 'hhh'.

Note that when levels are linked to make a matrix with more than 64 outputs, status of all outputs is transmitted as belonging to the first level. Status of a matrix that consists of levels 3, 4 and 5 (192 outputs), are shown by use of the SC:... command. 192 numbers, separated by commas, will follow.

### 1.2.5 Control

In general these messages can only be used when connected to the ESbus controller. However, commands '**Q**', '**Qnn**', '**Rnn**' and '**XR:..**' can also be used when connected to a tributary.

**Q** Host or controller asks for main status. The question is used for polling the other end. The polling takes place when no other traffic is present. The controller polls each 40th second if no other traffic. The host is free to select his own polling interval.

**Qnn** Controller or host returns main status. **nn** is explained in chapter 1.3.

**Rnn** Reset message with status sent if the unit has been reset. **nn** is stored as the status of the channel. May be used by host and controller. **nn** is explained in chapter 1.3.

The controller automatically returns the following message to the host when a reset is received.

**M** status of all outputs of all matrices

**XD001** Ask the controller to send "maximum input" parameter list.

**XD001:064,064,064,064,064,064,064,064**

Answer to the question XD001. The parameter list shows from left to right the maximum input number of levels 1 through 8.

**XD002** Ask the controller to send "maximum output" parameter list.

**XD002:064,064,064,064,064,064,064,064**

Answer to the question XD002. The parameter list shows from left to right the maximum output number of levels 1 through 8.

**XD003** Ask the controller to send "minimum input" parameter list.

**XD003:001,001,001,001,001,001,001,001**

Answer to the question XD003. The parameter list shows from left to right the minimum input number of levels 1 through 8.

**XD004** Ask the controller to send "minimum output" parameter list.

**XD004:001,001,001,001,001,001,001,001**

Answer to the question XD004. The parameter list shows from left to right the minimum output number of levels 1 through 8.

**XD005** Ask the controller to send "linked levels" parameter list.

**XD005:000,000,000,000,000,000,000**

Answer to the question XD005. The parameter list shows from left to right, the “linked levels” offset numbers of levels 1 through 8. Each parameter must be in the range “000” to “007”. “000” tells that the level is not linked to any other level, or the level is the main (start) level of several linked levels. “001” tells that the level is linked to the preceding level, and that the outputs are in the range 65 to 128. Similar, “002” tells that the level is linked to two preceding levels, and that the outputs are in the range 129 to 192.

Example: XD005:000,001,000,000,001,002,000,001      Levels 1 and 2 are linked to be a matrix with maximum 128 outputs. Level 3 is not linked and has maximum 64 outputs. Levels 4, 5 and 6 are linked to be a matrix with maximum 192 outputs. Levels 7 and 8 are linked to be a matrix with maximum 128 outputs.

**XR**      Host asks for controller release number.

**XR:<string>**

The matrix controller returns a string containing software release information. The string can typically look like:

XR: SYS2000 Controller Rel.2.7 981005

**XTA**      Host asks for addresses of tributaries connected to the ESbus

**XTA:<data>:**

ESbus controller returns information about which tributaries are connected to the ESbus. “<data>” will be “NONE”, or a number of ESbus addresses separated by commas. Note that the message ends with “:”. Examples:

XTA:NONE:

XTA:8293,8297,82AF,8295:

**XTS**      Host asks for information concerning all connected tributaries.

**XTS<tt>**      Host asks for information concerning tributary “<tt>”. “<tt>” is a number, starting with “00”. The number relates to the entry number in a table hold by the ESbus controller. In this table the tributaries of the system is listed. Normally an entry is made when the controller detects a new tributary. The order of which the tributaries are listed in the table is on a “when found” basis, and not sorted after ESbus address. Examples:

XTS00

XTS01



**XTStt:<data>**

ESbus controller returns tributary data as asked for. If format XTStt has been used when asking, data of one tributary is returned. If format XTS has been used when asking, data of all tributaries listed in the table is returned. Examples:

```
XTS00:11,82,89,04,00,00,01,00,07,00,00,00,00,00,00,00,.....
XTS01:31,82,F3,04,00,00,FF,00,FF,FF,FF,FF,FF,FF,FF,FF,00,00,.....
```

The "data" part is in total 32 bytes of information. With reference to the first example, some part of the data are described below:

```
11      Type of unit ( 11: control panel, 31: PC, 40: matrix )
82,89   ESbus address of unit
04      Last response from unit (04: ACK)
00
00
01      Level bitmap (01: level 1, 02: level 2, 03: levels 1&2,.. FF: all levels)
00
07      Output bitmap, outputs 1 to 8 (07: outputs 1, 2 and 3)
00      Output bitmap, outputs 9 to 16
00      Output bitmap, outputs 17 to 24
00      Output bitmap, outputs 25 to 32
00      Output bitmap, outputs 33 to 40
00      Output bitmap, outputs 41 to 48
00      Output bitmap, outputs 49 to 56
00      Output bitmap, outputs 57 to 64
..
```

Note that if no tributaries are listed in the internal ESbus controller table, no answer (other than ACK) will be given to XTS type question.

### 1.3 Status codes

The messages **Qnn** and **Rnn** contain messages about the status of the unit transmitting the message. At present the following status messages are defined:

```
nn      Status message

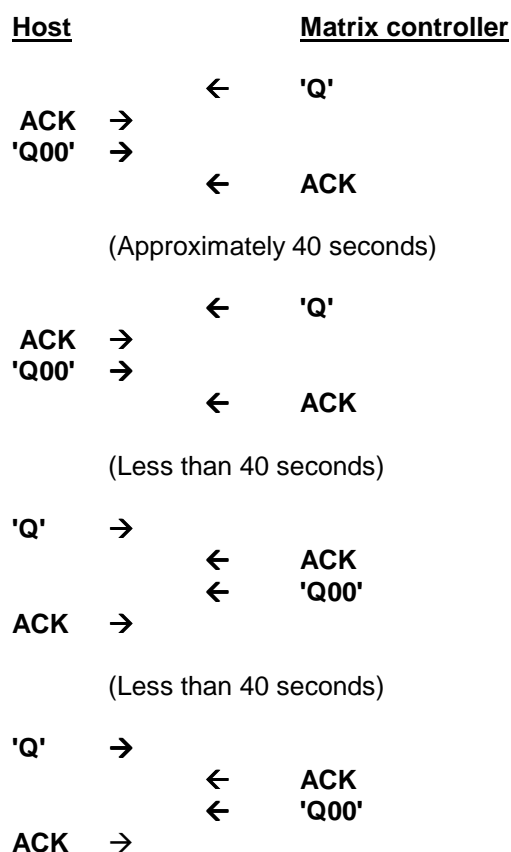
00      Status OK
02      Syntax error in received record
06      NAK character received
07      communication error (poll error)
```

## 1.4 Polling considerations

The matrix controller itself transmits polling messages 'Q' at an interval of approximately 40 seconds if no other traffic on the line. The host shall answer 'Q00' when receiving the polling question 'Q'.

If the host himself transmits polling questions, or transmits other Prosan messages to the controller, more often than each 40th second, the matrix controller will not send polling questions, but answer the polling-question from the host computer. The polling answer from the matrix controller will then be of the form 'Qnn', where 'nn' is the status of the matrix controller. Note than STX and ETX characters, as well as checksum characters are not listed in the example.

Example:



### 1.5 Host reset considerations

Use the format '**R00**' when transmitting a reset message from the host to the matrix controller. The matrix controller will answer by returning all matrix status records. You can also use the **Mooo**-type question to retrieve status of all the outputs, if you do not want to use the **R**-type message. If the host has been offline for a period longer than the poll time (Q-type message), it will also transmit all matrix status records when host again answers the Q-type poll. Note than STX and ETX characters, as well as checksum characters are not listed in the example.

Example:

<u>Host</u>		<u>Matrix controller</u>
'R00'	→	
		← ACK
		← 'Q'
ACK	→	
'Q00'	→	
		← ACK
		← 'M001:000,000,000,000,000,000,000,000'
ACK	→	
		← 'M002:000,000,000,000,000,000,000,000'
ACK	→	
		'status messages of all outputs/levels'
		← 'M064:000,000,000,000,000,000,000,000'
ACK	→	

The first Q-type poll message from the matrix controller can be issued anywhere in the sequence, not necessarily where indicated...

## 1.6 Sample communication when matrix is reset

When the matrix controller is reset (power reset or reset pushbutton) it will start to send **Q**-type poll messages until the host answers the poll. Then the matrix controller will send the '**R00**' message to inform about the reset situation. Thereafter it will transmit all matrix status records. Note than STX and ETX characters, as well as checksum characters are not listed in the example.

Example:

<u>Host</u>		<u>Matrix controller</u>
		Matrix controller reset
		← 'Q'
ACK →		
'Q00' →		
		← ACK
		← R00
ACK →		
		← 'M001:000,000,000,000,000,000,000,000'
ACK →		
		← 'M002:000,000,000,000,000,000,000,000'
ACK →		
		'status messages of all outputs/levels'
		← 'M064:000,000,000,000,000,000,000,000'
ACK →		

## 1.7 Communication when host orders matrix to make connection

Below is listed an example when the host orders the matrix to make the following connections:

Input 12 to output 8 in level 4  
 Input 18 to output 8 in level 5  
 Input 23 to output 16 in level 1  
 Input 2 to output 7 in level 2

Note that STX and ETX characters, as well as checksum characters are not listed in the example.

Example:

<u>Host</u>		<u>Matrix controller</u>
M008:---,---,---,012,018	→	
		← ACK
		← M008:---,---,---,012,018
ACK	→	
M016:023		→
		← ACK
		← M016:023
ACK	→	
M007:---,002	→	
		← ACK
		← M007:---,002
ACK	→	

The matrix controller can return a status message different from the one sent to the controller. This can happen when the matrix controller receives commands from more than one source (host). The host software therefor must look at the messages from the controller as change in status, ordered by any unit connected to the matrix controller. In such circumstances it also possible that messages are transmitted at the same time from host and controller. ACK character can then be inserted in the message body and must be removed (and used) by the receiver (ref. 1.1, full duplex transmission).

## 1.8 Matrix 'Input 000' considerations

The matrix controller can be programmed to allow for disconnecting inputs or not:

Input '000' (and '00') is used as the **disconnect code** of the matrix. You can use this input number to disconnect any input connected to an output.

However, many users want to inhibit this function. They always want a source connected to a given output. If no valid input status of an output exists within the matrix controller, the output is connected to the default input. In this case, commanding an output to be switched to input '000' is the same as commanding the output to be switched to the default input. Most often, the default input is the first input of the matrix. The customer can specify a different default input number when ordering the matrix.

### 1.9 Communication when host asks for alarm status

Below is listed a few examples when the host asks the matrix for alarm status:  
Note that STX and ETX characters, as well as checksum characters are not listed in the example.

#### Example 1 :

The host asks with question AM, wanting the alarm status of all units of the system to be returned, sorted per level and ESbus address:

<u>Host</u>		<u>Matrix connected</u>
AM	→	
		← ACK
		← AMA001,064:8289,00
ACK	→	
		← AMB001,064:8287,01,0A
ACK	→	
		← AMC001,064:8285,01,02
ACK	→	
		← AMC065,128:8283,00
ACK	→	
		← AMD:0000,00
ACK	→	
		← AME001,032:828B,00
ACK	→	
		← AMF001,032:828D,00
ACK	→	
		← AMG001,032:828F,00
ACK	→	
		← AMH001,032:8291,00
ACK	→	

There is one matrix in level 1 and no alarm is present. This matrix manages outputs from 1 to 64.

There is one matrix in level 2 and alarm 0x0A is present. This matrix manages outputs from 1 to 64.

There are two matrices in level 3. Alarm 0x02 is present on board address 0x8285 (managing outputs from 1 to 64) and no alarm on board 0x8283 (managing outputs from 65 to 128).

There is no matrix in level 4.

There is one matrix in levels 5, 6, 7 and 8 and no alarm is present (each matrix manages outputs from 1 to 32).

Example 2:

The host asks with **AMF**, wanting the alarm status of all units of the system working on level 6 to be returned, sorted per level and ESbus address:

<u>Host</u>		<u>Matrix connected</u>
AMF	→	
		← ACK
		← AMF001,064:8289,00
ACK	→	
		← AMF065,128:828B,02,02,03
ACK	→	
		← AMF129,192:828D,01,04
ACK	→	

There are three matrices in level 6. No alarm is present on board address 0x8289 (managing outputs from 1 to 64). Note that in hardware, levels with more than 64 outputs occupy next levels. In this example hardware levels 6, 7 and 8 are used to manage 192 outputs, but all outputs are mapped to the same virtual level (6).

Alarms 0x02 and 0x03 are present on board address 0x828B (managing outputs from 65 to 128).

Alarm 0x04 is present on board address 0x828D (managing outputs from 129 to 192).

Example 3:

The host asks with **AMC,D,E**, wanting the alarm status of all units of the system working on levels 3, 4 and 5 to be returned, sorted per level and ESbus address:

<u>Host</u>		<u>Matrix connected</u>
AMC,D,E	→	
		← ACK
		← AMC001,032:8283,01,05
ACK	→	
		← AMD001,032:8285,00
ACK	→	
		← AME001,032:8287,00
ACK	→	

The matrix on level 4 is board addressed 0x8283 and alarm 0x05 is present.

The matrix on level 5 is board addressed 0x8285 and no alarm is present.

The matrix on level 6 is board addressed 0x8287 and no alarm is present.

### 1.10 PROSAN communication channel

The matrix controller communicates with a host computer, PC or similar, via a serial channel:

Type:	RS-232-C or RS-422
Speed:	9600 baud (or on request)
Data bits:	7
Stop bits:	1
Parity:	odd
Cable length:	RS-232-C specifications generally limit the cable length to 15 meters. However, at baud-rates lower than 19200 baud, the cable length can be increased (depends upon environment, and type of cable). Typical cable length of more than 100 meters are possible at 1200 baud.

Cable length for an RS-422 connection is typically maximum 1200 meters.